Preliminary

Ultra-low Density Fiberboard and Sandwich Panel*[1]

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Introduction

Plywood, which has been the dominant panel for structural purposes, is currently facing stiff competition with reconstituted composite boards such as oriented strand board (OSB) and particleboards due to the diminishing supply of large diameter peeling logs. Some of the drawbacks of using plywood as construction material are its poor thermal and sound insulation properties. Particleboards and OSB on the other hand are relatively inferior in specific mechanical strength properties. An economically viable and environmentally friendly substitute structural panel with properties that can bridge aforementioned deficiencies is obviously needed.

This study aims to produce thick, structural fiberboards overlaid with veneers, i.e., sandwich panels, with improved thermal insulation property while retaining satisfactory strength and dimensional stability even at very low board density. The fundamental physical and heat insulation properties of low density fiberboards and sandwich panels were discussed.

Materials and Methods

Two types of panel products were produced in this study, namely, low density fiberboards and veneer overlaid fiberboards (sandwich panels).

For the production of low density fiberboards, short fibers were prepared from radiata pine (*Pinus radiata* D. Don) using PDDR and long fibers were prepared from yellow cedar (*Chamaecyparis nootkatensis* Spach) using PSDR. Foam-type and bond-type polymeric isocyanate were used at 10 and 30% resin content levels. The fibers were formed with a fiber-mat former which was newly designed in laboratory scale. The formed fiber-mat was

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pressed into 370×360×12 mm size fiberboards with the density of 0.05–0.5 g/cm^3 with steam injection press. On the other hand, yellow cedar fibers were used for the core and the lauan (*Shorea* spp.) rotary veneers of 0.55, 1.0 and 2.0 mm thicknesses were used for the faces in the production of sandwich panels. Bond-type polymeric isocyanate was sprayed on the fiber at a resin content levels of 10 and 30%. The veneers were spread with similar resin type at 75 g/m^2, solid basis, and overlaid on the fiber-mat faces. The assembled sandwich panels were then pressed to target densities of 0.35 and 0.45 g/cm^3 with steam injection press.

Results and Discussion

Fiber geometry, resin type or content effected on both the mechanical and dimensional properties of the fiberboards. These fiberboards produced were of good dimensional stability and of high mechanical strength in spite of its low density. This is due to the use of isocyanate compound resin with steam injection press. These properties were further enhanced by overlaying with veneers.

Fig. 1 shows relationship between parallel modulus of rupture and density of sandwich panels in dry condition. The moduli of rupture of sandwich panels with density of about 0.35 g/cm^3 showed the values of around 20–30 MPa. However, the panels with density of about 0.35 g/cm^3 experienced horizontal shear failure in the core during static bending, while the higher density panels exhibited tensile failure at the bottom veneer surface. For the higher density panels, the improvement effect of thickening face veneers on the strength was prominent. The specific moduli of rupture of sandwich panels were found to be greater

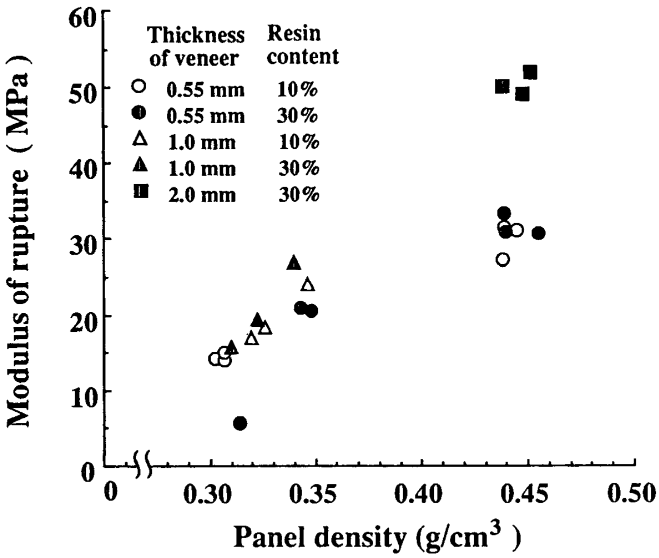

Fig. 1. Relationship between parallel modulus of rupture and density of sandwich panels in dry condition.

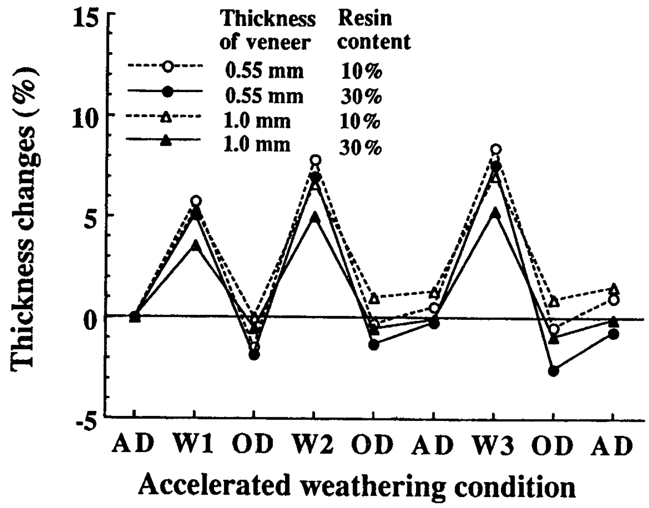

Fig. 2. Thickness changes of panels with the mean density of 0.35 g/cm^3 under the accelerated weathering conditions. Notes : AD ; Air-dry condition, OD; Oven-dry condition at 60°C for 24 hrs, W1 ; Water-soaking at 20°C for 24 hrs, W2 ; Water-soaking at 70°C for 24 hrs, W3 ; Boiling for 2 hrs and water-soaking at 20°C for 1 hr.

than those of commercial plywood and other wood based composite panels.

Fig. 2 shows the thickness changes of sandwich panels with the mean density of 0.35 g/cm^3 under the accelerated weathering condition. The dimensional stabilities of these panels are very good, as the final thicknesses of the panels after the test were almost the same as the original thickness, that is to say, springback was hardly observed. The thickness swelling was less than 6% after soaking in 20°C water for 24 hours and less than 9% even after the boiling condition.

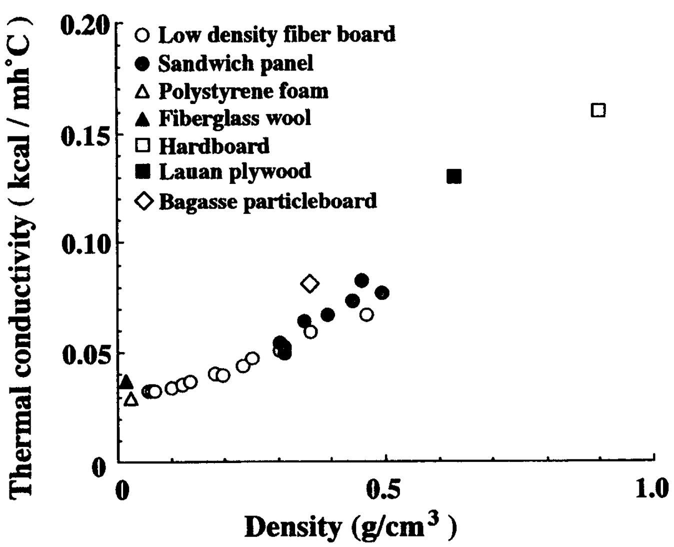

Fig. 3. Comparison between the thermal conductivity of low density fiberboards and sandwich panels with other materials.

Fig. 3 shows comparison between thermal conductivity of low density fiberboards and sandwich panels with some other materials. The thermal conductivity of low density boards depends more on its density than on the structure. The thermal conductivity of low density fiberboards is very low and almost equivalent to those of thermal insulation materials such as polystyrene foam and fiberglass wool. The thermal conductivity of sandwich panels is much lower than that of the commercial plywood.